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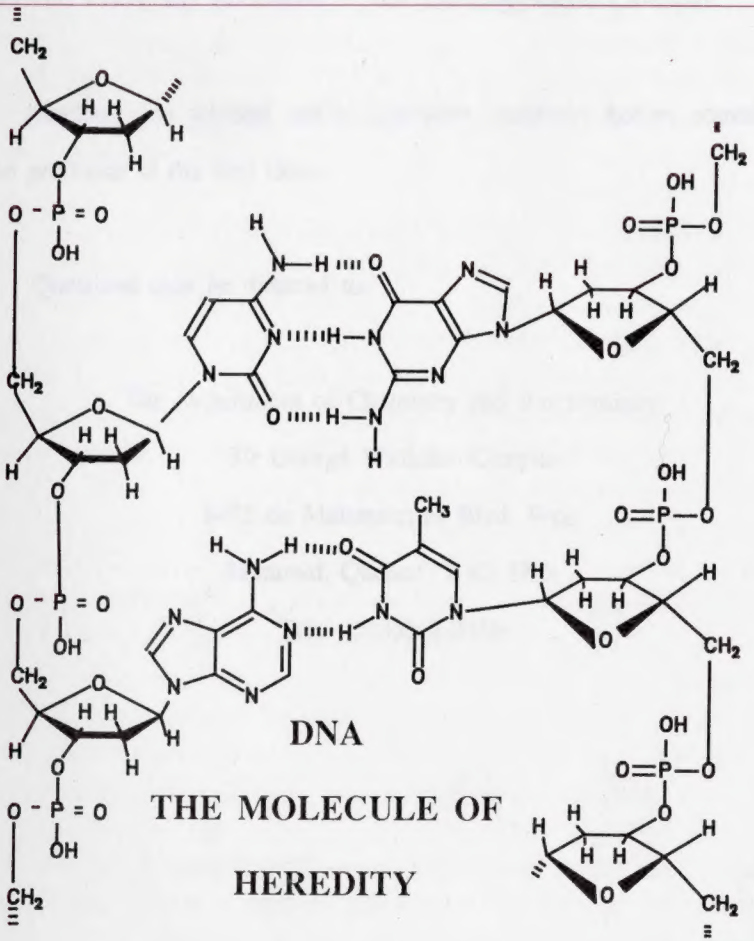
UNIVERSITY

ARTS AND SCIENCE
CHEMISTRY AND BIOCHEMISTRY



DNA

THE MOLECULE OF

HEREDITY

1990-91

CONCORDIA UNIVERSITY

DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

COURSE GUIDE

This guidebook was prepared to give the prospective student an overview of the Department, the facilities and the programmes. **Some of the information in this booklet is subject to change. The Official University document is The Undergraduate Calendar.**

Students are advised not to purchase textbooks before consulting the professor at the first class.

Questions may be directed to:

The Department of Chemistry and Biochemistry

Sir George Williams Campus

1455 de Maisonneuve Blvd. West

Montreal, Quebec H3G 1M8

Tel: (514)848-3366

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The Science of Chemistry

> "The study of chemistry is profitable, not only inasmuch as it promotes the material interests of mankind, but also because it furnishes us with insight into those wonders of creation which immediately surround us, and with which our existence, life and development are most clearly connected."
>
> Justus Von Liegib (1851)

Science is a systematic study of ourselves and our environment, that is, the physical objects and the phenomena that occur in our world. Science is perhaps the most dominant human endeavour of our time. Through science we have gained some insight into the laws of nature and learned to manipulate the environment to our advantage. Much of modern day living is founded on the advances in science.

Chemistry is a dynamic science which deals with the structure and behaviour of matter. It is concerned with the composition of matter and the changes it undergoes, this includes complex biological material and simple substances, such as water. Chemistry has led to such innovations as drugs and medicines to fight disease, fertilizer and pesticides, gasoline, improved food and clothing, plastics, etc. All of us benefit from the practical applications of chemistry research.

Chemistry, like the other sciences, is very complex and chemists have become specialized. Chemistry has the subdivisions of physical, inorganic, analytical, organic and biochemistry and some of these have narrower subdivisions, such as bioinorganic chemistry. Each is based on the same fundamental principles of chemistry, but deals with a rather specific part of chemistry. These divisions are all inter-dependent. Many of the important discoveries have been the result of team-work involving chemists from the various sub-divisions.

Our cover logo, the simplified and schematic partial structure of a nucleic acid called deoxyribonucleic acid (DNA), the molecule of heredity, was elucidated through the co-operation of all branches of

chemistry. Biochemists isolated the compound, analytical chemists learned its composition, organic chemists studied the structure of components and synthesized models of it. The physical chemists elucidated the overall structure of this huge molecule, using physical methods like X-ray crystallography, and biochemists again studied its function in transmitting all hereditary properties of all living organisms from generation to generation. The importance of all this knowledge cannot be overestimated. The researcher, in close co-operation with colleagues continues to establish the intricate details of the correlation between structure and function.

OBJECTIVE OF THE CHEMISTRY DEPARTMENT

The Chemistry Department aims to offer the best undergraduate education in chemistry whether it is for a student who is intending to be a specialist, or one who is taking courses in chemistry as a requirement of some other career or for general interest. The faculty and facilities of the department are chosen with this aim in mind. Students are encouraged to meet individually with faculty members.

ADMISSION REQUIREMENTS

Quebec students usually enter the first year of the 90-credit programme after completing the two year CEGEP programme. These students are expected to have completed the "Science Profile" as established through joint action of the Quebec universities and the provincial Department of Education. This profile includes the following courses: Mathematics 103, 203, Physics 101, 201, 301; Chemistry 101, 201 and Biology 301. Graduates of the three year CEGEP technical programme are also admissible.

Students from outside the province may also apply for admission. They may be admitted directly to the 90-credit programme or to an extended credit undergraduate programme depending upon the qualification submitted. Consult the University Calendar for details.

Students who have not completed collegial studies and are over 21 years of age may apply for admission provided they meet the other criteria as a mature student. Students who wish to use the alternative entry provisions should consult the "Mature Student Programme" in the University Calendar.

All students must make sure that they follow the requirements set out in their letter of admission.

More detail is available in Section 13 of the Undergraduate Calendar.

REGISTRATION, COURSE LOADS AND ACADEMIC REGULATIONS

Each student will receive a package of information regarding the Registration process, which includes the registration dates. It is possible to early register; this avoids long lines and increases the possibility of registering before the various courses are filled. Students must see a Department Advisor who will help you choose your courses and plan your programme. It is mandatory to have an advisor approve your courses before Registration. You must make an appointment with an advisor:

Telephone: 848-3355

Make sure you bring a copy of your academic record and your letter of admission when you meet the advisor.

The normal course load for a full-time student is 30 credits for the academic year. (Note: enrolling in less than 24 credits in an academic year will make a student ineligible for many scholarships, bursaries or loans). Only the Vice-Dean for Student Affairs of the Faculty of Arts and Science can approve a course overload for a student. Please read the Undergraduate Calendar for deadlines (Section 11) and regulations (Section 16) regarding course changes, withdrawals etc. Make sure that you understand the Degree Requirements and

Academic Performance Regulations (Section 31.003) for the Faculty of Arts and Science.

THE DEPARTMENT AND ITS FACILITIES

A list of the full-time faculty members in the department is shown below. Although most courses are taught by full-time faculty, there is a variable number of adjunct professors and part-time lecturers. There are over 18 support staff, which includes technicians, secretaries, laboratory assistants etc. The faculty teach and do research in the major areas of chemistry.

The department has teaching laboratories on both campuses, but research is concentrated at the Sir George Williams Campus where the major research instrumentation is located.

Some of the major facilities include: The Canadian Centre for Picosecond Laser Spectroscopy, this unit is for flash photolysis on the picosecond and nanosecond time scale; a laser spectroscopy laboratory, X-ray diffraction and nuclear magnetic resonance. Other units, such as the Laboratory for Inorganic Materials and The Science Industrial Research Unit are located within the department.

The department offers graduate programmes at the master's and doctoral levels. Full details of these are found in the Graduate Faculty Calendar or through the department's Graduate Programme Director. The faculty is actively involved in research in Analytical Chemistry, Biochemistry, Inorganic Chemistry and Organic Chemistry and they direct masters and doctoral students in their thesis work. Our undergraduate students have a first-hand opportunity to engage in a research project with a faculty member of their choice.

FACULTY

Chairman and Professor
P.H. Bird

Professors
L.D. Colebrook
C.H. Langford
N. Serpone
O.D. Tee

Assistant Professors
F. Ablenas
M.F. Bell
J.A. Capobianco
B.C. Hill
R. Khan
M.F. Lawrence
S. Mikkelsen

Research Associate
D.K. Sharma

Associate Professors
T.J. Adley
M.E. Baldwin
S.J. Daunt
M. Doughty
A. English
Z. Hamlet
M.G. Hogben
M.J. Kornblatt
R. Le Van Mao
R.H. Pallen
R.T.B. Rye
R.E. Townshend
G.J. Trudel
R.A. Westbury
R.H. Zienius

UNDERGRADUATE DEPARTMENT ADVISOR

Ms. D. Gordon
Office: H-1139 (Hall Building)
Telephone: 848-3355

Please note that it is mandatory to see the department advisor before registering for courses. It is advisable to make an appointment.

COOPERATIVE PROGRAMME DIRECTOR

Dr. R.H. Zienius
Office: H-1151 (Hall Building)
Telephone: 848-3352

SCHOLARSHIP, AWARDS, MEDALS, PRIZES AND FINANCIAL AID

A number of scholarships and prizes are available to students in Chemistry. Full details about these and other financial aid may be found in Sections 18 and 19 of the Undergraduate Calendar.

THE COURSE NUMBERS

Course numbers consist of three digits. The first digit is an indication of the level of the course. Two hundred level courses are normally taken during the first year and will have Chemistry 205 and 206 as prerequisites and possibly other 200 level courses. Three hundred level courses are normally taken during second year. These will have 200 level courses as prerequisites and possibly some at the 300 level. The 400 level courses are taken in the final year and will have 300 level courses as prerequisites. They may require some 400 level courses to be taken previously or concurrently.

Students are advised to note the prerequisites carefully when planning their programmes.

The second digit in the course number indicates a field of chemistry. A zero indicates a field of general interest, 1 designates analytical chemistry, 2 designates organic chemistry, 3 physical chemistry, 4 inorganic chemistry, 5 a research course, 7 biochemistry, 8 industrial or environment chemistry and 9 instrumentation.

The third number in the numbering sequence is used to designate the different courses within a field. For example the number 231 would indicate the first course in physical chemistry at the introductory level.

SUMMER COURSES

There is a limited number of courses offered in the summer session. Most are courses of the second semester of the second year, offered as part of the Chemistry Coop programme schedule. Other students may enrol in these courses if there is space available.

The courses which are open to all students, and which normally have been offered are: CHEM 205, 206 and 233.

CHEMISTRY PROGRAMMES

Programmes are offered in Chemistry, Analytical Chemistry and Biochemistry. A students may follow any of these programmes at a level that suits their particular requirements.

Honours/Specialization

Honours is the same as the Specialization, except that a student must make an application to be admitted to Honours status and must maintain a specified academic standard to qualify for an Honours degree, see Undergraduate Calendar Section 16.2.4 and Section 31.003. An Honours student must take CHEM. 450: Research Project and Thesis. Universities in provinces other than Quebec offer Honours and Major programmes. In the majority of Quebec universities these became Specialization and Minor, but the English sector retained the Honours.

Honours was the traditional entrance requirement for graduate school, however, a Specialization is equally acceptable.

Note: A graduate with an Honours degree or a Specialization degree, or equivalent, is eligible for membership in the Quebec Order of Chemists and thus is able to practice as a chemist in Quebec. A working knowledge of French is required.

Students in a Major programme can become eligible for admission to the Quebec Order of Chemists either by registering for additional courses in Chemistry so that the requirements of the Order are met, or by writing the examinations set by the Order.

Major/Minor

These programmes do not provide a sufficient depth in chemistry to pursue a career in chemistry. However, they may be combined with programmes in other disciplines where a knowledge of chemistry is useful for the student's chosen career. The major is essentially the core programme, whereas the minor is 24 credits chosen to form a coherent group of courses to complement the student's other areas of study.

The course composition of these programmes is as follows:

(Note: A description of each course is given after the section on programmes.)

CORE PROGRAMME IN CHEMISTRY (45 Credits)

	Credits
CHEM. 217 Introductory Analytical Chemistry I	3
CHEM. 218 Introductory Analytical Chemistry II	3
CHEM. 221 Introductory Organic Chemistry I	3
CHEM. 222 Introductory Organic Chemistry II	3
CHEM. 231 Physical Chemistry : Introduction	2
CHEM. 232 (formerly 332) Physical Chemistry : Thermodynamics	2
CHEM. 233 Physical Chemistry: Spectroscopy & Quantum Theory	2
CHEM. 241 Inorganic Chemistry I : Introduction to Periodicity and Valence Theory	3
CHEM. 271 Introductory Biochemistry	3
CHEM. 312 Intermediate Analytical Chemistry	3
CHEM. 324 Organic Chemistry III : Organic Reactions	3
CHEM. 325 Organic Chemistry IV : Organic Structure & Stereochemistry	3
CHEM. 331 Physical Chemistry : Kinetics	2
CHEM. 338 Physical Chemistry Laboratory I	2
CHEM. 339 Physical Chemistry Laboratory II	2

and

Students in Biochemistry programmes will also take

CHEM. 374 Macromolecular Synthesis	3
CHEM. 375 Intermediary Metabolism	3

or

Students in the other programmes will also take

CHEM. 242 Inorganic Chemistry II : The Chemistry of the Main Group Elements	3
CHEM. 341 Inorganic Chemistry III : The Transition Metals	3

(Note: This reflects some proposed changes to the numbering scheme.)

SPECIALIZATION IN CHEMISTRY (60 Credits)

Core Programme Courses	45
MATH. 220 Mathematical Methods in Chemistry	3
CHEM. 419 Independent Study and Practicium	
or, with Departmental permission	6
CHEM. 450 Research Project and Thesis	
Additional credits in Chemistry	6

SPECIALIZATION IN BIOCHEMISTRY (69 Credits)

Core Programme Courses	45
BIOL. 261 Genetics	3
BIOL. 270 Introductory Microbiology	3
BIOL. 364 Cell Physiology	3
CHEM. 479 Advanced Biochemistry Laboratory	3

and 6 Credits chosen from:

CHEM. 471 Enzyme Kinetics & Mechanism	
CHEM. 473 Medicinal Chemistry I	
CHEM. 474 Medicinal Chemistry II	
CHEM. 475 Pharmacology I	6
CHEM. 476 Pharmacology II	
CHEM. 478 Hormone Biochemistry	
CHEM. 481 Bioinorganic Chemistry	
CHEM. (a 400-level course)	3
BIOL. (a 400-level course)	3

SPECIALIZATION IN ANALYTICAL CHEMISTRY (63-64 Credits)

Core Programme Courses	45
CHEM. 290 Laboratory Automation and Data Handling	3
CHEM. 328 Analytical Organic Chemistry & Spectroscopy	3
CHEM. 392 Introductory Instrumentation	
or	3
PHYS. 295 Experimental Electronics I (2 credits)	
and	4
PHYS. 296 Experimental Electronics II (2 credits)	
CHEM. 398* Selected Topics in Chemistry	
or	3
CHEM. 498* Advanced Topics in Chemistry	
*(These must be Analytical Chemistry)	
CHEM. 419 Independent Study and Practicium	
or, with permission	6
CHEM. 450 Research Project and Thesis	

HONOURS IN CHEMISTRY (60 Credits)

This programme can be any one of the SPECIALIZATION programmes with the inclusion of CHEM. 450. See Section 16.2.4 and 31.003 of the Undergraduate Calendar for performance requirements. Admission to this programme is by application only, see the Department Advisor.

MAJOR IN CHEMISTRY (45 Credits)

The courses are those described in the Core Programme. With prior approval of the Department Advisor, courses in related fields may be used as substitutions up to a maximum of 9 credits.

MAJOR IN BIOCHEMISTRY (45 Credits)

This programme consists of the Core Programme, but without CHEM. 232, 312, 338 and 339, which are replaced by 9 credits chosen from CHEM. 479, BIOL. 261, 270 and 364.

SPECIALIZATION IN GEOLOGY-CHEMISTRY (78 Credits)

This is a joint specialization consisting of courses offered by both departments. This programme is described in the Undergraduate Calendar in the Geology Department, Section 31.140.

(Note: graduates from this programme are not eligible for membership in the Order of Chemists of Quebec).

SPECIALIZATION IN SYNTHETIC MATERIALS (64 Credits)

	CREDITS
CHEM. 217 Introductory Analytical Chemistry I	3
CHEM. 218 Introductory Analytical Chemistry II	3
CHEM. 221 Introductory Organic Chemistry I	3
CHEM. 222 Introductory Organic Chemistry II	3
CHEM. 231 Physical Chemistry : Introduction	2
CHEM. 233 Physical Chemistry : Spectroscopy and Quantum Theory	2
CHEM. 241 Inorganic Chemistry I : Intro. to Periodicity and Valence Theory	3
CHEM. 302 Industrial Chemistry, Resources and Environment	2
CHEM. 312 Intermediate Analytical Chemistry	3
CHEM. 327 Organic Chemistry of Polymers	3
CHEM. 328 Analytic Organic Chemistry & Spectroscopy	3
CHEM. 482 Properties and Models of the Solid State	3
MATH. 262 Advanced Calculus I	3
MATH. 263 Advanced Calculus II	3
PHYS. 253 Electricity and Magnetism I	3
PHYS. 254 Electricity and Magnetism II	3

In addition 8 credits from the following courses:

CHEM. 232 Physical Chemistry : Thermodynamics	2
CHEM. 419 Independent Study & Practicium	6
CHEM. 435 Physical Chemistry of Polymers	3
CHEM. 492 Chemical Spectroscopy	4

CHEM. 498 Advanced Topics in Chemistry	3

(Must be in Heterogeneous catalysis, organometallic chemistry or inorganic solid state chemistry)

PHYS. 232 Theoretical Physics I	3
PHYS. 252 Optics	3
PHYS. 335 Theoretical Physics II	3
PHYS. 355 Electronics II	3
PHYS. 396 Methods of Experimental Physics	4

The student must take at least 6 credits at the 400 level and the mathematics and statistics options must be approved by the Programme Director.

(Note: Graduates of this programme do not meet the eligibility requirement of the Quebec Order of Chemists.)

CERTIFICATE IN SCIENTIFIC MEASUREMENT (Chem.Option) (33 Credits)
This programme is designed to meet some very specific needs.

CHEM. 217 Introductory Analytical Chemistry I	3
CHEM. 218 Introductory Analytical Chemistry II	3
CHEM. 290 Laboratory Automation and Data Handling	3
CHEM. 312 Intermediate Analytical Chemistry	3
CHEM. 392 Introductory Instrumentation	3
CHEM. 491 Advanced Instrumentation	4
PHYS. 295 Experimental Electronics I	2
PHYS. 296 Experimental Electronics II	2
PHYS. 396 Computer Electronics	5
PHYS. 397 Experimental Medical Electronics	5

SOME COURSE NUMBER EQUIVALENTS

Several course numbers have been changed and some courses have been split into two courses. To help reduce confusion some equivalences of course numbers are listed.

CHEM. 211 = CHEM. 217 plus CHEM. 218
CHEM. 332 = CHEM. 232
CHEM. 328 = CHEM. 311 plus CHEM. 316 plus CHEM. 391
CHEM. 338 = CHEM. 238 plus CHEM. 239
CHEM. 339 = CHEM. 330 plus CHEM. 337

COOPERATIVE EDUCATION PROGRAMME

The "Coop" Programme in Chemistry/Biochemistry has the same academic course requirements as the Honours or Specialization programmes taken by regular stream undergraduates. However, Coop students alternate their academic semesters with off-campus paid work terms in government or industrial laboratories where they are employed as chemists/biochemists in-training. Students who are above average academically, and interested in the Coop Programme should refer to the announcement in the Undergraduate Calendar, Section 31.515. In addition, more specific information may be obtained from the Director of the Chemistry/Biochemistry Coop Programme, Dr. Raymond H. Zienius (Telephone: 848-3352), or from the Institute for Cooperative Education (Telephone: 848-3953).

SCIENCE COLLEGE

Students planning to register in one of the programmes of the Department might consider joining the Science College. In Science College students will gain an understanding of several areas of science while specializing in one that they choose. It is an opportunity to become acquainted with science as practiced and understood by scientists today. The goals of the Science College are to provide an opportunity for experience in a research environment, for thinking about the nature of science, and for becoming aware of the style and content

of the various scientific disciplines. Students planning to register in a Specialization or a Major in the Department of Chemistry and Biochemistry are eligible for admission to Science College provided they meet the other entrance requirements of the College. See section 31.550 of the Undergraduate Calendar or telephone 848-2595.

COURSE DESCRIPTIONS

Note: This list of courses does not imply that all of these courses will be offered in any particular year. Students must refer to the current schedule of courses for this information.

This section contains general descriptions of course contents. The names of the instructors are those that have taught the course recently and there may be changes, depending upon scheduling and work-loads. No text books are listed. Students are cautioned against buying textbooks, references, etc. without the advice of the instructor at the first class.

A student may be exempted from one or more of the introductory courses, on the basis of work done at CEGEP level. Where exemptions are given, the courses must be replaced with an equivalent number of credits in the sub-discipline involved, in order that the student successfully completes any of the programmes approved by the Order of Chemists of Quebec.

Courses that consist of both laboratories and lectures require that a satisfactory performance be obtained in <u>each</u> of the components for successful completion of the course.

Chemistry 205 General Chemistry I 3 credits

Instructors: M. Doughty, R.H. Pallen, G.J. Trudel

Prerequisites: none

For: Mature Students and students who have not taken CEGEP level chemistry, students who wish to obtain some knowledge of chemistry or to continue in chemistry. This course, together with Chem. 206, is a prerequisite for all other courses in chemistry except Chem. 208. Students in programmes leading to the B.Sc. degree may not take this course for credits to be applied to their programme of concentration.

Format: Lectures and lab.

Basis of Grading: Combination of tests, lab. work and final exam.

Description: This course is intended to provide students with a knowledge of basic concepts in chemistry. Among the topics discussed are stoichiometry; states of matter, atomic and molecular structure, the periodic table and periodicity and chemical bonding.

Note: Students in programmes leading to the B.Sc. degree may not take this course for credit to be applied to their programme of concentration.

Chemistry 206 General Chemistry II 3 credits

Instructor: M. Doughty, R.H. Pallen

Prerequisites: Chemistry 205

For: Same as Chemistry 205

Format: Lectures and laboratories

Basis of Grading: Combination of tests, lab. work and final exam.

Description: Thermochemistry, solutions and their properties, equilibrium, ionic equilibria, pH, buffers, kinetics, reaction mechanisms, other selected topics related to biochemistry, biology, and engineering.

Note: Students in programmes leading to the B.Sc. degree may not take this course for credit to be applied to their programme of concentration.

Chemistry 208 Chemical Hazards in the Work Environment 3 Cr.

Instructor: M. Hogben
Prerequisites: none
For: Students not registered for a B.Sc.
Format: Lectures
Basic of Grading: Term paper, mid-term and final exams.
Descriptions: An introduction to chemistry, chemical hazards and the social history of chemistry. Toxicity, combustion, corrosion, explosives, radiation and water reactive materials in the work environment are studied. An aim of the course is to help the student establish the chemical vocabulary and concepts necessary to understand the social impact of chemistry in relation to occupational health and safety, firefighting and enviromental hazards. No previous knowledge of chemistry is assumed since the non-quantitative knowledge is developed throughout the course.

Note: This course may not be taken for credit by science students.

Chemistry 217 Introductory Analytical Chemistry I 3 credits

Instructors: A. English, S. Mikkelsen, G.J. Trudel, R.H. Zienius
Prerequisites: CEGEP Chem 201, Phys. 301, Math 102, 203 or equiv.
For: Degree programmes in chemistry and biochemistry and certificate in measurement.
Format: Lectures and lab.
Basis of Grading: Class tests, final exam, lab work
Description: An introduction to the basic theories involved in analytical chemistry, as demonstrated by acid/base, complexations and solubility product equilibria. The laboratory gives practice in the classical methods of gravimetric and volumetric methods of analysis, which are fundamental procedures used in obtain the most accurate results in modern analytical chemistry.

Note: Students who have received credit for CHEM. 211 or GEOL. 324 may not take this course for credit.

Chemistry 218 Introductory Analytical Chemistry II 3 Credits

Instructors: A. English, S. Mikkelsen, R.H. Zienius
Prerequisites: Chem. 217
For: Degree programmes in chemistry and biochemistry and certificate in measurement.
Format: Lectures and lab.
Basis of Grading: Class Tests, final exam, lab work
Description: A continuation of the study of basic theories of analytical chemistry as applied to precipitation titration and redox equilibria. This is followed by an introduction to the more commonly used instrumental analytical techniques, including: potentiometry and molecular, atomic and fluorescence spectroscopy. The laboratory provides practice in the use of basic instrumentation.

Note: Students who have received credit for CHEM. 211 or GEOL. 324 may not take this course for credit.

Chemistry 221 Introductory Organic Chemistry I 3 Credits

Instructors: T.J. Adley, L.D. Colebrook, M. Doughty
Prerequisites: Chemistry 206 or equivalent
For: All programmes in Chem., biochem., biol. and ex. sc.
Format: Lectures and lab.
Basic of Grading: Midterm and final exams, laboratory work.
Description: Basic aspects of orbitals and their role in covalent bonding. Acids and bases. Delocalization of electrons. Alkanes, their structures, isomerism and nomenclature. Introductory stereochemistry. Enantiomers, diastereomers, conformers, Fischer projections, Cahn-Ingold-Prelog sequence rules for specification of chirality. E/Z-isomerism. Conformations of cyclic compounds. Alkyl halides, S_N1, S_N2, E1, E2 reactions, their mechanisms and stereochemistry. Free-radical reactions, organometrallic compounds. Chemistry of alcohols, ethers and related compounds.

Chemistry 222 Introductory Organic Chemistry II 3 credits

Instructors: F. Ablenas, T.J. Adley, M.E. Baldwin, M. Doughty
Prerequisites: Chem. 221 or equivalent
For: All degree programmes in chem., biochem., biol. and ex. sc.
Format: Lectures and lab.
Basis of Grading: Laboratory work, midterm and final exams.
Description: Introduction to the use of IR and NMR spectroscopy for identification of simple organic compounds. Chemistry of alkenes, alkynes and dienes. Electrophilic additions, Markovnikov's rule, conjugate additions, Diels-Alker reaction, polymerization. Benzenes, Huckel rule and aromaticity. Electrophilic aromatic substitution, its mechanism and orientation. Chemistry of aldehydes and ketones. Reduction, Wittig, and Grignard reactions. Aldol condensation. Chemistry of carboxylic acids and their derivatives. Chemistry of amines. Simple reaction mechanisms.

Chemistry 231 Physical Chemistry : Introduction 2 credits

Instructors: S. Daunt, R.E. Townshend, R.A. Westbury
Prerequisites: CEGEP Chem. 201, Phys. 301, Math. 103, 203 or equiv.
For: Degree programmes in chem., biochem., and analytical chem.
Format: Lectures
Basis of Grading: Midterm and final exams
Descriptions: First law of thermodynamics, thermochemistry, entropy, the second and third laws of thermodynamics, free energy and chemical equilibrium, electrochemical cells and the Nernst equation, the Gibbs-Helmholtz equation. Applications of thermodynamics to systems of chemical interest.

Chemistry 232 Physical Chemistry : Thermodynamics 2 credits

Instructor: R.A. Westbury
Prerequisite: Chem. 231
For: Degree programmes in chem., biochem., and analytical chem.
Format: Lectures
Basis of Grading: Midterm and final exams
Description: Comparison of closed and open systems, partial molal quantities, chemical potential, real gases, fugacity, equilibrium constant, free energy function ideal solutions, real solution, Duhem-Margules equation.

Note: At present this course is listed in the calendar and schedule as CHEM. 332.

Chemistry 233 Physical Chemistry : Spectroscopy and Quantum Theory 2 credits

Instructor: M.F. Lawrence, R.T. Rye, R.E. Townshend, R.A. Westbury
Prerequisites: CEGEP Chemistry 201, Physics 301 or equiv. and Math. 220
For: Degree programmes in chem., biochem., and analytical chem.
Format: Lectures
Basis of Grading: Midterm and Final Exams
Description: This course in intended to introduce the student to the basic ideas of quantum mechanics, spectroscopy and the electronic structure of atoms and molecules. Topics covered include the origins and postulates of quantum theory; applications to simple systems; the hydrogen atom; the aufbau principle of the elements; simple molecules. Spectroscopy and spectroscopic measurements; simple atomic spectra; infra-red and Raman spectra of simple molecules, fluorescence, N.M.R.

Chemistry 238 Physical Chemistry Laboratory I 1 credit

Instructor: R. Le Van Mao
Prerequisites: Chem. 232 (see 332)
For: Degree programmes in chem., biochem., and analytical chem.
Format: Laboratory
Basis of Grading: Laboratory work and reports.
Description: Introduction to experimental procedures involved in determining basic physical properties of liquids and gases.

Note: Insubsequent years this course will be combined with CHEM. 239 and given as CHEM. 338.

This course will normally be taken in Year II.

Students who have credit for CHEM. 338 may not take this course for credit.

Chemistry 239 Physical Chemistry Laboratory II 1 credit

Instructor: R. Le Van Mao
Prerequisite: Chem. 232
For: Degree programmes in chem., biochem., and analytical chem.
Format: Laboratory
Basis of Grading: Laboratory work and reports.
Description: Application of more advanced techniques for the determination of the basic physical properties of liquids, solids and gases.

Note: In subsequent years this course will be combined with CHEM. 238 and given as CHEM. 338.

This course will normally be taken in Year II.

Students who have credit for CHEM. 338 may not take this course for credit.

Chemistry 241 Inorganic Chemistry I : Introduction to Periodicity and Valence Theory 3 credits

Instructors: P.H. Bird, M.G. Hogben, C.H. Langford, N. Serpone
Prerequisites: CEGEP Chem. 201, Phys. 301, Math 103, 203 or equiv.
For: Degree programmes in chem., biochem. and analytical chem.
Format: Lectures, problem sessions and laboratory
Basis of Grading: Assignments, mid-term and final exams
Description: The structure of the atom, covalent bonding, chemical forces, complex ions, crystal field theory. Bonding theories of metals and semi conductors.

Chemistry 242 Inorganic Chemistry II. Chemistry of the Main Group Elements 3 credits

Instructors: G. Dénès, M.G. Hogben
Prerequisites: CEGEP Chem. 201, Phys. 301, Math 103, 203 or equiv.
For: Degree programmes in chemistry and analytical chemistry
Format: Lectures and laboratory
Basis of Grading: Assignments, mid-term and final exams
Description: A survey of the properties and reactions of: Hydrogen, Group IA (Lithium to Cesium) and Group IIA (Beryllium to Radium): Ionic bonding, Boron, Group IIIA Nitrogen, Group VB (Phosphorus to Bismuth), Oxygen, Group VIB (Sulphur to Polonium), the Halogens, the Noble gases, Group IIB (Zinc, Cadmium and Mercury).

Chemistry 271 Introductory Biochemistry 3 credits

Instructors: B.C. Hill, R. Khan, M.J. Kornblatt
Prerequisite: Chem. 222
For: Degree programme in chemistry, biochemistry and analytical chemistry
Format: Lectures and laboratory
Description: This course is an introduction to the essentials of biochemistry. Topics discussed are protein structure, enzymology, carbohydrate metabolism and its regulation; an overview of bioenergetics, nucleic acids and protein biosynthesis.

Note: Students who have received credit for CHEM. 371 or CHEM. 372 or CHEM. 373 may not take this course for credit.

Chemistry 290 Laboratory Automation and Data Handling 3 cr.

Instructor: R.A. Westbury
Prerequisites: Comp. 212 or equivalent, Chem. 218 previously or concurrently and permission of the department
For: Specialization in analytical chemistry
Format: Lectures, tutorials and laboratory
Basis of Grading: Laboratory work, midterm and final exams
Description: Introduction to some modern techniques used to transduce and manipulate raw chemical data. Topics to be discussed will include: statistical treatment of chemical data, using programmes written in Basic, or other high-level language; the use of binary, decimal, and hexadecimal numbers; programming a single-board computer or modern microcomputer using machine and assembly languages; input-output operations; elementary interfacing techniques. Experiments will involve the collection and treatment of data for common laboratory instruments such as electrodes and photodetectors.

Chemistry 302 Industrial Chemistry, Resources and Environment 2 credits

Instructor: M.G. Hogben

Prerequisites: Students must be registered in a program in chemistry and be within 42 credits of graduation or permission of the dept.

For: Optional Course

Format: Lectures

Basis of Grading: Tests and final exam

Description: An introduction to chemical engineering for chemists. Management and conservation of resources; pollution control; occuptational and environmental health; technological and environmental impact assessment.

Chemistry 304 Chemical Technology and Human Values 3 credits

Instructor: M.G. Hogben

Prerequisites: Must be registered in a Chemistry programme and be within 42 credits of graduation, or permission of the Department.

For: Optional course

Format: Lectures

Basis of Grading: Tests and final exam

Description: The history of technology; the impact of chemistry on material life; appropriate technologies; chemistry and war; the social responsibility of the scientist.

Note: Students who have received credit for CHEM. 303 may not take this course for credit.

Chemistry 312 Intermediate Analytical Chemistry 3 credits

Instructor: M.F. Bell, R.H. Zienius
Prerequisite: Chem. 218
For: Degree programme in chem., biochem., and analytical chem.
Format: Lectures and Laboratory
Basis of Grading: Mid-term and final exams, laboratory work
Description: This course is a continuation of Chem. 218 with emphasis on instrumental analysis. Techniques discussed include emission spectroscopy; X-ray spectroscopy; voltammetry and polarography, amperometric titrations; coulometry and coulometric titrations; conductometry; chromatography with particular emphasis on gas chromatography and high performance liquid chromatography. Laboratory work is done concurrently and provides experience in the techniques discussed in lectures.

Note: Students who have received credit for any of CHEM. 310, CHEM. 314, CHEM. 315 or CHEM. 319, may not take this course for credit.

Chemistry 324 Organic Chemistry III : Organic Reactions 3 cr.

Instructor: Z. Hamlet
Prerequisite: Chem. 222 or equivalent, Chem. 331 previously or concurrently.
For: Degree programmes in chem., biochem., and analytical chem.
Format: Lectures and Laboratory
Basis of Grading: Mid-term and final exams, laboratory work.
Description: This course is a mechanistic survey of reactions of major synthetic utility. It deals with reactions mechanisms and the importance of reactive intermediates such as carbocations, carbanions, radicals and carbenes.

Note: Students who have received credit for CHEM. 322 may not take this course for credit.

Chemistry 325 Organic Chemistry IV : Organic Structure and Stereochemistry 3 credits

Instructor: T.J. Adley, Z. Hamlet
Prerequisites: Chem. 222 or equivalent,, Chem. 331 previously or concurrently
For: Degree programmes in chem., biochem., and analytical chem.
Format: Lectures and Laboratory
Basis for Grading: Mid-term and final exams, laboratory work.
Description: The course examines organic structure and stereochemistry including the relationship of stereochemistry to physical properties and chemical reactivity. The use of chemical and spectroscopic means to determine structure and stereochemistry is included. The laboratory work involves the identification of organic compounds.

Note: Students who have received credit for CHEM. 321 may not take this course for credit.

Chemistry 326 Natural Products 3 credits

Instructor: L.D. Colebrook
Prerequisite: Chem. 222 or equivalent
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Structure determination, synthesis, and stereochemistry of various natural products. Examples from terpenes, carotenoids, steroids, alkaloids, and pheromones.

Note: Students who have received credit for Chem. 398A may not take this course for credit.

This course has been given previously as Chem. 398A.

Chemistry 327 Organic Chemistry of Polymers 3 credits

Instructor: R.H. Pallen
Prerequisites: Chem. 222 or equivalent
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Introduction to the fundamental aspects of polymers and polymerization. Methods of preparation, reaction mechanisms of polymer synthesis. Includes the various types of mechanism: condensation, free radical, anionic, cationic and Ziegler-Natta or heterogeneous polymerizations.

Note: Students who have received credit for CHEM. C328 may not take this course for credit.

Chemistry 328 Analytical Organic Chemistry and Spectroscopy 3 credits

Instructor: TBA
Prerequisites: Chem. 217, 218, 222 and 233
For: Specialization in Analytical Chemistry
Format: Lectures and Laboratory
Basis of Grading: Mid-term and final exams, laboratory work
Description: Principles of physical, chemical and instrumental methods of identification and analysis of organic compounds. 'Wet' chemistry as a means of functional group identification. Protocol of identification of unknown organic compounds by chemical and spectroscopic methods. Application of vibrational, electronic, nuclear magnetic resonance and mass spectrometric techniques in the elicidation of structure of organic compounds.

Note: Students who have received credit for CHEM. 311 and CHEM. 316, or CHEM. 391 may not take this course for credit.

Chemistry 330 Physical Chemistry Laboratory III 1 credit

Instructor: R. Le Van Mao
Prerequisite: Chem. 232, Chem. 331 previously or concurrently
For: Degree programmes in chem., Biochem., and analytical chem.
Format: Laboratory
Basis of Grading: Laboratory work and reports
Description: Investigation of some interactions that occur between solids, liquids, and gases.

Note: Students who have credit for CHEM. 339 may not take this course for credit.

In subsequent years this course will be combined with CHEM. 337 and be given as CHEM. 339.

Chemistry 331 Physical Chemistry : Kinetics 2 credits

Instructors: S. Daunt, R.T. Rye, O.S. Tee
Prerequisites: CHEM. 233
For: Degree programmes in chem., biochem., and analytical chem.
Format: Lectures
Basis of Grading: Mid-term and final exams, assignments
Descriptions: Kinetic molecular theory. Topics in chemical-reaction kinetics, including: mechanisms of elementary reactions; theories of chemical reaction rates; free-radical reactions; factors influencing rates of reactions in solution; acid-base catalysis; catalysis by enzymes; the Michaelis-Menten mechanism; inhibition in enzyme-catalyzed reactions.

Chemistry 332 Physical Chemistry : Thermodynamics 2 credits

Note: In subsequent years this course will be given as CHEM. 232. Please see description of CHEM. 232 for course content and information.

Chemistry 337 Physical Chemistry Laboratory IV 1 credit

Instructor: R. Le Van Mao
Prerequisites: Chem. 331
For: Degree programmes in chem., biochem., and analytical chem.
Format: Laboratory
Basis of Grading: Laboratory work and reports
Description: Kinetic and mechanistic studies of chemical reactions.

Note: Students who have credit for CHEM. 339 may not take this course for credit.

In subsequent years CHEM. 330 and CHEM. 337 will be combined and offered as CHEM. 339.

Chemistry 338 Physical Chemistry Laboratory: 1 2 credits

Note: In subsequent years CHEM. 238 and CHEM. 239 will be combined to form CHEM. 338. See these course descriptions for information.

Chemistry 339 Physical Chemistry Laboratory: 2 2 credits

Note: In subsequent years CHEM. 330 and CHEM. 337 will be combined to form CHEM. 339. See these course descriptions for information.

Chemistry 341 Inorganic Chemistry III : The Transition Elements 3 credits

Instructors: P.H. Bird, J.A. Capobianco

Prerequisites: Chem. 211, 241, 242

For: Degree programmes in chemistry and analytical chemistry

Format: Lectures and Laboratory

Basis of Grading: Mid-Term and Final exam, laboratory work

Description: Theories of bonding in transition metal complexes, including ligand field theory, applied to structure, physical properties, and reactivity of transition metal complexes: organometallic chemistry and catalysis. Metal in Biological systems. Lectures and laboratory.

Note: Students who have received credit for CHEM. 342 or CHEM. 348 may not take this course for credit.

Chemistry 374 Macromolecular Synthesis 3 credits

Instructor: TBA

Prerequsite: Chem. 271

For: Specialization biochemistry

Format: Lectures and problem sessions

Base of Grading: Mid-term and final exams

Description: Synthesis of proteins, nucleic acids, lipids; synthesis and assembly of complex structures such as membranes, ribosomes, etc. Lectures and problem sessions.

Note: Students who have received credit for CHEM. 371 or CHEM. 372 or CHEM. 373 may not take this course for credit.

Chemistry 375 Intermediary Metabolism 3 credits

Instructor: B.C. Hill, R. Khan, M.J. Kornblatt
Prerequisite: Chem. 271
For: Specialization biochemistry
Format: Lectures and laboratory
Basis of Grading: Mid-term and final exams, lab. work and reports.
Description: This course surveys selected pathways in intermediary metabolism including their regulation and physiological significance; the urea cycle; fatty acid oxidation; biosynthesis of nucleosides, tetrapyrroles, carotenoids, cholesterol and steroidal hormones. The biosynthesis of vitamins and cofactors and the metabolism of selected aminoacids may also be discussed.

Note: Students who have received credit for Chem. 371 or 372 or 373 may not take this course for credit.

Chemistry 389 Industrial Chemical Laboratory 1 credit

Instructor: TBA
Prerequsites: Chem. 222, 232, 233, previously or concurrently
For: Optional course
Format: Laboratory
Basis of Grading: Laboratory work and reports
Description: A course designed to provide the student with an understanding of the philosophies of industrial quality control, and of industrial research and development. Common industrial techniques will be studies, including laboratory safety; measurement of physical properties; synthetic procedures, both organic and inorganic; and various separation techniques. Several instrumental analytical methods will be employed, and a final report on the work of the term will be submitted.

Chemistry 392 Introductory Instrumentation 3 credits

Instructor: R.A. Westbury
Prerequisite: Chem. 218 or two-6 credit Biol. courses with laboratory
For: Optional course
Format: Lectures and laboratory
Basis of Grading: Mid-term, final and lab. exam
Description: Introduction to measurement principles. Instrument design and basic techniques; analysis of amplifiers, integrators, filter circuits, and other basic modules used in chemical instrumentation. In the laboratory, transistor and IC circuits are studied, as well as some of the mechanical, optical and electrical transducers and recorders used in modern chemical instrumentation.

Note: Students who have received credit for CHEM. 390 or CHEM. 397 or CHEM. 399 may not take this course for credit.

Chemistry 398 Selected Topics in Chemistry 3 credits

Courses under this number and heading are scheduled as the demand and opportunity arises. There is no guarantee that a particular topic will be scheduled in any particular year. Students are advised to consult the schedule.

Topics that have been offered in the past few years are noted below:

Chem. 398A Natural Products (See Chem. 326) 3 credits

Chem. 398B Bioorganic Chemistry 3 credits

Instructor: F. Ablenas
Prerequisite: Chem. 222
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Organic chemistry of biomolecules such as carbohydrates, nucleotides, nucleosides, amino acids, proteins and redox-related heterocycles such as nicotinamide and flavin. Intrinsic reactivity of functional groups, selective protection strategies, synthesis and degradation will be discussed, especially with respect to the exploitation of biomolecules as a pool of chiral materials.

Chemistry 412 Statistical Methods in Chemistry 3 credits

Instructor: R.A. Westbury
Prerequisite: Chem. 218
For: Optional course
Format: Lectures
Basis of Grading: Assignments, mid-term and final exam
Description: A study of some of the methods used by chemists to analyze data, systematically collate data, and plan the efficient collection of further data. As much as possible, the class discussions will draw upon chemical examples, but there will not be a heavy emphasis on theoretical proofs. Use of the University's computers is encouraged for doing assignments.

Note: See Chem. 498Z

Chemistry 419 Independent Study and Practicum 6 credits

Instructor: The faculty
Prerequisites: A grade of C (grade point average of 2.00) in 31 credits of the core programme courses, acceptance by a supervisor, confirmation by the Coordinator of Senior Thesis (Dr. R.H. Zienius). This must be done before registering in course.
For: All Specialization programmes
Format: Laboratory and conferences
Basis of Grading: Written report of laboratory work and oral examination by a committe of Department members.
Description: In collaboration with and under the direction of a faculty member, the student carries out independent study and practical work on a problem chosen from the student's area of concentration.

Chemistry 421 Physical Organic Chemistry 3 credits

Instructor: O.S. Tee
Prerequisites: Chem. 322 (or Chem. 325), 331
For: Optional course
Format: Lectures
Basis of Grading: Assignments and final exam
Description: Determination of organic reaction mechanisms using kinetics, activation parameters, acid-base catalysis, Bronsted catalysis law, solvent effects, medium effects, isotope effects, substitutent effects and linear free energy relationships.

Chemistry 422 Organic Synthesis 4 credits

Instructor: T.J. Adley
Prerequisite: Chem. 322 or Chem. 325
For: Optional course
Format: Lectures and laboratory
Basis of Grading: Assignments, laboratory work, final exam
Description: Consideration of synthetic strategy and synthesis design. Modern synthetic methods and reagents, exemplified by syntheses of terpenes, alkaloids, pheromones, and novel structures.

Chemistry 423 Heterocylcic Chemistry 3 credits

Instructor: O.S. Tee
Prerequisites: Chem. 322 or 325
For: Optional course
Format: Lectures
Basis of Grading: Assignments, final exam
Description: Survey of the chemistry of 3-,4-,5-, and 6- membered heterocycles, with a particular emphasis on heteroaromatic systems. Synthesis and reactions of heterocycles; their use in synthesis; factors affecting their reactivity.

Note: See CHEM. 498K

Chemistry 435 Physical Chemistry of Polymers 3 credits

Instructor: R.E. Townshend
Prerequisite: Chem. 222, 232 (or 332)
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Physical properties of polymers; polymer-solution theory; molecular-weight distributions and fractionation; molecular-weight determinations by colligative properties, light-scattering and ultra-centrifuge techniques; kinetics of condensation and addition polymerizations; co-polymerization. Lectures and problem sessions.

Note: Students who have received credit for CHEM. 335 or CHEM. 336 may not take this course for credit.

Chemistry 441 Single Crystal X-Ray Diffraction 3 credits

Instructor: P.H. Bird
Prerequisites: Chem. 325
For: Optional course
Format: Lectures
Basis of Grading: Assignments and final exam.
Description: Space group symmetry, diffraction of X-rays by single crystals, photographic and counter methods of diffraction data collection. Solution and refinement of crystal structures. Interpretation of atomic coordinates and vibrations.

Note: See Chem. 498I

Chemistry 442 Physical Methods in Inorganic Chemistry
3 credits

Instructor: P.H. Bird
Prerequisites: Chem. 328, 341
For: Optional course
Format: Lectures
Basis of Grading: Assignments
Description: Introduction to symmetry and the character tables. Diffraction methods, X-ray, ESCA, UV-Visible, ORD and CD, EPR, Mössbauer, NQR, NMR, IR, and Raman.

Chemistry 444 Mössbauer Spectroscopy and Magnetic Properties of Materials 3 credits

Instructor: G. Dénès
Prerequisites: Chem. 241, 242, and 341 previously or concurrently
For: Optional course
Format: Lectures
Basis of Grading: Class tests, assignments, final exam.
Description: Introduction to the crystalline state, X-ray and neutron diffraction. Vibrational properties of solids, phonons. Magnetic properties of materials: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism and other ordered states. Theory of the Mössbauer effect, hyperfine interactions. Examples of Mössbauer studies: iron, tin, other main group elements, other transition elements, lanthanides and actinides. Combined studies of solids by X-ray and neutron diffractions, magnetic measurments and Mössbauer spectroscopy.

Note: See CHEM. 498M

Chemistry 445 Heterogeneous Catalysis 3 credits

Instructor: R. Le Van Mao
Prerequisite: Chem. 231
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exam, assignments.
Description: Surface phenomena in heterogeneous catalysis (adsorption; texture of solids; introduction to the main techniques for the characterization of catalysts). Relationships between surface properties and catalyst activities (basic concepts in Catalysis). Catalytic kinetics. Catalytic reaction systems (introduction to the theory of catalytic reactors; diffusion, heat and mass transfer within porous solids; shape selectivity; catalyst activity decay). Industrial Catalysis : new trends.

Note: See CHEM. 498N

Chemistry 446 Electrochemistry 3 credits

Instructor: M.F. Bell
Prerequisites: Chem. 231, 331 or Department permission
For: Optional course
Format: Lectures
Basis of Grading: Assignments, mid-term and final exam (or reseach paper).
Description: This course covers a specialized area of physical and analytical chemistry and, in particular, develops concepts introduced in CHEM. 218 and 312. The theory behind these concepts is further described to explain the principles of corrosion and battery research and development.

Note: See CHEM. 498O

Chemistry 447 Electronic Spectroscopy 3 credits

Instructor: J.A. Capobianco
Prerequisites: Chem. 233, 341
For: Optional course
Format: Lectures
Basis of Grading: Paper, oral presentation of paper, final exam.
Description: This course is intended to provide the student with the theoretical background necessary to understand and work with electronic spectra, to illustrate and discuss the methods involved in assigning spectral transitions, and to explain the spectra which have been found for the transition metal ions in various oxidation states and symmetries.

This course assumes that the students has some knowledge of atomic structure, molecular symmetry and group theory.

Note: See CHEM. 498R

Chemistry 449 Laboratory in Synthesis and Techniques in Inorganic Chemistry 1 credit

Instructor: P.H. Bird
Prerequisite: Chem. 442 previously or concurrently
For: Optional course
Format: Laboratory
Basis of Grading: Laboratory work and reports
Description: Some of the techniques discussed in Chem. 442 will be employed in the laboratory to characterize and determine properties of compounds synthesized at the laboratory.

Chemistry 450 Research Project and Thesis 6 credits

Instructor: The faculty

Prerequisite: Third year standing in Honours Chemistry (Completed 60 credits), or permission of the department (provided the student has a grade point average of 3.00 (B) or better, for all Core Programme Courses.

For: Honours programme or students with permission

Format: Laboratory and conferences

Basis of Grading: Written thesis and oral defence of work before the faculty.

Description: The student works on a research project, in the student's area of concentration, selected in consultation with and conducted under the supervision of a faculty member of the Department; and writes a thesis on the results. The project is also the subject of a seminar before the Department.

Note: Students planning to take this course must consult with the Chemistry Department as early as possible the year before the final year.

Chemistry 471 Enzyme Kinetics and Mechanism 3 credits

Instructor: M.J. Kornblatt

Prerequisites: Chem. 271; 60 credits in Chemistry

For: Optional course in biochemistry programmes

Format: Lectures

Basis of Grading: Mid-term, final exams, and assignments. (No supplementals allowed in this course.)

Description: Steady state kinetics, including the use of initial velocity studies and project inhibition to establish a kinetic mechanism; non-steady-state kinetics, isotope effects, energy of activation, etc; detailed mechanisms of selected enzymes.

Chemistry 472 Chemical Toxicology 3 credits

Instructor: M.E. Baldwin
Prerequisites: Chem. 271 and 3rd year standing or Department permission.
For: Optional course
Format: Lectures
Basis of Grading: Assignments, final exam
Description: Introduction to the general principles of toxicology with emphasis on the toxic effects of chemicals in humans. Dose-response relationship, types and routes of exposure, absorption and disposition of toxic substances, toxicokinetics, types of toxic response and factors affecting toxic response. Toxicity testing, risk assessment and interpretation of toxicological data.

Note: See Chem. 498V

Chemistry 473 Medicinal Chemistry I 3 credits

Instructor: TBA
Prerequisites: Chem. 271, 60 credits in Chemistry
For: Required for Med. Chem. Option in Biochemistry Specialization
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Physiochemical Principles of drug action. Influence of solubility, surface phenomena, stereochemistry and electronic properties on drug action. Nonspecific drugs, anaesthetic, membrane-active disinfectants and antibiotics. Quantitative structure-activity relationships. Receptor theory and models, methods of receptor characterization.

Chemistry 474 Medicinal Chemistry II 3 credits

Instructor: TBA
Prerequisites: Chem. 473 or permission of the department.
For: Required for Med. Chem. Option in Biochemistry Specialization
Format: Lectures
Basis of Grading: Term paper and final exam
Description: Drugs acting on endogenous messengers and their targets: Cholinergic, adrenergic, dopaminergic and serotoninergic neuronal systems. Histamine, amino acid neurotransmitters. Steroid and peptide hormones, prostaglandins. Enzymes as drug receptors. Drug design.

Chemistry 475 Pharmacology I 3 credits

Instructor: TBA
Prerequisites: Chem. 271, Biol. 333
For: Required for Med. Chem. Option in Biochemistry Specialization
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Topics discussed include: Pharmacokinetics, drug metabolism and interaction. Toxicology, carcinogeneticy, and teratogeneticy. Drug development and testing.

Chemistry 476 Pharmacology II 3 credits

Instructor: TBA
Prerequisite: Chem. 475 or permission of the department.
For: Optional course
Format: Lectures
Basis of Grading: Project, mid-term and final exams
Description: Autonomic nervous system pharmacology. Functions of central nervous system, depressants, stimulants. Narcotic analgesics, addition. Cardiovascular, renal, and endocrine pharmacology.

Chemistry 478 Hormone Biochemistry 3 credits

Instructor: TBA
Prerequisites: Chem. 271 and third-year standing (60 crs completed)
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: This course deals with an in-depth study of the vertebrate hormones and involves a study of the precise chemical structure and properties of each hormone, its biosynthesis and mode of secretion from the cell. The circulating form of the hormone is examined, as well as the nature of the hormone receptor. The cellular mechanism of action and the relationship of the hormone's action to the intact animal are investigated.

Chemistry 479 Advanced Biochemistry Laboratory 3 credits

Instructor: R. Khan, M.J. Kornblatt
Prerequisite: Must have a grade of C- (grade point of 1.70) or better, in 31 credits of the 45-credit Core Programme.
For: Programmes in biochemistry
Format: Laboratory
Basis of Grading: Laboratory work, reports, final exam
Description: This course deals with the theory and practice of modern biochemical laboratory techniques. Laboratory only.

Chemistry 481 Bioinorganic Chemistry 3 credits

Instructor: A. English
Prerequisites: Chem. 241, 271
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Role of metals in biochemical systems. Essential trace elements, zinc enzymes, oxygen transport and storage, metalloproteins and biological electron transfer, structure-function relationships in heme enzymes, nitrogen fixation; model compounds for metalloproteins and metalloenzymes.

Chemistry 482 Properties and Models of the Solid State 3 credits

Instructor: C.H. Langford
Prerequisites: Chem. 232, 328 or department permission
For: Specialization in Synthetic Materials
Format: Lectures
Basis of Grading: Mid-term and final exams
Description: Crystal structure and the receiprocal lattice; lattice dynamics; free electron theory; band theory; semiconductors; dielectric and magnetic properties of solids.

Chemistry 491 Advanced Instrumentation 4 credits

Instructor: TBA
Prerequisites: Chem. 392
For: Optional course
Format: Lectures and laboratory
Basis of Grading: Mid-term and final exams, lab work, reports.
Description: A study of the amplifiers, transducers, and other circuit elements used to acquire data in chemistry, in the analog, time, and digital data domains. A study of these circuits as regards optimization, frequency response, sampling parameters, signal-to-noise enhancement and budget error analysis. Some of the concepts involved in computer interfacing, for both control and data collection, are discussed. In the laboratory, selected experiments illustrate the topics discussed in lectures. Lectures and laboratory.

Note: Students who have received credit for CHEM. 490 or CHEM. 497 or CHEM. 499 may not take this course for credit.

Chemistry 492 Chemical Spectroscopy 4 credits

Instructor: S. Daunt
Prerequisites: Chem. 324 (or 321) and 328
For: Optional course
Format: Lectures and laboratory
Basis of Grading: Mid-term and final exams, laboratory work, reports
Description: Theory and application of EPR spectroscopy, rotational spectroscopy, rotation-vibrational spectroscopy, Raman spectroscopy. Lectures and laboratory.

Chemistry 493 Magnetic Resonance Spectroscopy 3 credits

Instructor: L.D. Colebrook
Prerequisite: Chem. 221 or equivalent
For: Optional course
Format: Lecture
Basis of Grading: TBA
Description: This course is designed to provide the background in magnetic resonance theory necessary to understand modern high-resolution NMR experiments and instrumentation. The basic theory in the introductory section also applies to electron spin resonance (ESR). Relaxation and through-bond and through-space interactions, and experiments to investigate them, are considered. Spin manipulations and behaviour in multiple-pulse, Fourier transform NMR techniques used for common spectral editing and two-dimensional experiments are discussed.

Note: See Chem. 498L

Chemistry 494 Mass Spectrometry 3 credits

Instructor: R.T. Rye
Prerequisite: Chem. 331
For: Optional course
Format: Lectures
Basis of Grading: Mid-term and final exams.
Description: Production and interpretation of mass spectra. Topics to be covered will include: ionization methods (electron impact, chemical ionization and fast-atom bombardment); interpretation of mass spectra; introduction to quantitative analysis by mass spectrometry.

Note: See Chem. 498T

Chemistry 498 Advanced Topics in Chemistry 3 credits

Courses under this number and heading are scheduled as the demand and opportunity arises. There is no guarantee that a particular topic will be scheduled in any particular year. Students are advised to consult the schedule.

Some topics that have been offered in the past few years are noted below:

- Membrane Biochemistry (B.C. Hill)
- Advanced Bio-organic Chemistry (O.S. Tee)
- Heterocyclic Chemistry (See Chem. 423) (O.S. Tee)
- Magnetic Resonance Spectroscopy (see Chem. 493) (L.D. Colebrook)
- Mössbauer Spectroscopy and Magnetic Properties of Materials (see Chem. 444) (G. Dénès)
- Electrochemistry (see Chem. 446) (R. Le Van Mao)
- Photochemistry (N. Serpone)
- Electronic Spectroscopy (see Chem. 447) (J.A. Capobianco)
- Crystal Chemistry (G. Dénès)
- Mass Spectroscopy (R.T. Rye)
- Bio-analytical Chemistry (S. Mikkelsen)
- Catalytic Processes in the Chemical Industry (R. Le Van Mao)
- Homogeneous Catalysis (P.H. Bird)
- Statistical Methods in Chemistry (see Chem. 412) (R.A. Westbury)
- Single Crystal X-Ray Diffraction (see Chem. 441) (P.H. Bird)

Chemistry 499 Advanced Topics in Chemistry 6 credits

See "Note" for Chem. 498